ORIGINAL ARTICLE

THE DIAGNOSTIC ACCURACY OF SONOGRAPHY IN CHILDREN SUSPECTING INTUSSUSCEPTION KEEPING SURGICAL FINDINGS AS A GOLD STANDARD

Pari Gul,[1] Muhammad Ayub Mansoor,[1] Roomi Mahmud,[1] Ameet Jesrani,[1] S. Mustansir H. Zaidi[2]

[1] Department of Radiology, Liaquat National Hospital, Karachi, Pakistan.
[2] Department of Statistics, Liaquat National Hospital, Karachi, Pakistan.

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ABSTRACT

BACKGROUND: Intussusception occurs when a segment of bowel invaginates into an immediately adjacent segment, often likened to a telescope. Ultrasound is the primary imaging modality for initial diagnosis with high accuracy approaching 100% with sensitivity of 98% to 100% and specificity of 88% to 100%. It also help to determine whether the involved bowel should be reduced or surgically resected. **OBJECTIVE:** To evaluate the diagnostic accuracy of sonography in children suspecting intussusception keeping surgical findings as a gold standard. **METHODS:** Total 192 children presented with clinical triad of colicky abdominal pain, vomiting and jelly stools since last 5 hours were included. Ultrasound was performed and serial longitudinal and transverse images were assessed. All the patients diagnosed as having signs of irreducible intussusception like free fluid, absent blood flow on color Doppler were followed after surgery. Sensitivity, specificity, and accuracy of ultrasound were calculated using surgical procedure as gold standard. **RESULTS:** The male were 109 (56.8%) and female were 83 (43.2%). The mean age was 4.3 ± 2.3 years. On ultrasound examination, intussusception was diagnosed in 33 patients. In surgical procedure it was diagnosed in 31 patients. The overall sensitivity of ultrasound was 83.9%, specificity was 95.7% and diagnostic accuracy was 93.7%. **CONCLUSION:** Ultrasonography is an accurate, safe and valuable clinical tool in the diagnosis of acute intussusception in children.

Key words: Diagnostic Accuracy, Ultrasonography, Intussusceptions, Surgical findings

Introduction

Intussusception is the most common abdominal emergency situations in infants and small children.[1] Clinical presentation includes irritability, intermittent crying, abdominal colic, bile-stained vomiting, red jelly stools and palpable abdominal mass. The triad of intermittent abdominal pain, vomiting and right upper-quadrant abdominal mass has a positive predictive value of 93%.[2] It is one of the most common causes of bowel obstruction in infancy leading to intestinal necrosis, bowel resection and even death if not recognized and treated appropriately.[3] Intussusception occurs when a segment of bowel invaginates into an immediately adjacent segment, often likened to a telescope.[1] Four types of intussusception are described; Ileocolic-intussusception is the most common type, accounting for over 80% of cases in children.[1] Intussesception seems to be idiopathic in 90% of cases and is associated with Pathologic lead points such as meckel's diverticulum, solid bowel lesion and intestinal lymphoma. It can occur postoperatively and after blunt abdominal trauma.[3]

The incidence of intussusception in infants ranges

Correspondence : S. Mustansir H. Zaidi
Department of Statistics,
Liaquat National Hospital,
Karachi, Pakistan.
Mobile: +92-312-9298804
Email: mustansir.zaidi@gmail.com

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from 0.3 to 4 cases per 1,000 live births in Europe, North America and Australia, but in some developing countries a higher incidence and a high rate of complications have been described.[3] It occurs predominantly in males, with peak incidence between 6 months and 2 years of age after which the incidence gradually declines. It commonly occurs in the spring and winter seasons.[4-5]

Ultrasound is the primary imaging modality for initial diagnosis in the developing countries. Sonography screening in children has been suggested to reduce cost, radiation exposure and both patient and parental anxiety/discomfort with enema. Ultrasound also plays a role in identifying alternative diagnoses as well as the evaluation of reducibility of an intussusception, the presence of a lead point mass and intussusception limited to the small bowel. Published series suggest high accuracy approaching to 100% in experienced hands, with sensitivity of 98%-100% and specificity of 88%-100%.[6-7] The advantages of ultrasound are that it allows non-invasive, rapid and confident diagnosis with lack of ionizing radiation as compared to CT scan and barium enema. It can be done at bed side even with less experienced readers. It also help to determine whether the involved bowel should be reduced or surgically resected. Inability to detect blood flow in the intussusception predicts the need for surgery.[8]

The rationale of this study was to form a noninvasive easily available modality to diagnose intussusception in children so that timely intervention could be done to reduce morbidity and mortality.

Materials & Methods

Total 192 children of both genders, age below 12 years presented with clinical triad of colicky abdominal pain, vomiting and jelly stools since last 5 hours were included in this cross sectional study to determine the diagnostic accuracy of sonography in children suspecting intussusception keeping surgical findings as a gold standard. The sample subjects were selected through Radiology department, Liaquat National Postgraduate Medical Centre, Karachi, from January 2012 to July 2012. The approval of institutional research & ethical committee and informed consent was taken prior to commencement of the study. The sample size was calculated by using sensitivity and specificity of ultrasound for diagnosis of intussusceptions. The sample was collected through non-probability consecutive sampling technique.

Brief history regarding duration and symptoms of intussusception were sought. Ultrasound was performed using probes of 3.5 MHz and 8.0 MHz on Aplio Toshiba machine.

Serial longitudinal and transverse images were taken and assessed by a consultant radiologist. Presence of following ultrasound features was considered intussusception present

- Target sign (doughnut sign): The appearance was generated by concentric alternating echogenic and hypoechogenic bands. The echogenic bands were formed by mucosa and muscularis whereas the submucosa is responsible for the hypoechoic
- Pseudo kidney sign: The psedo kidney sign of Intussesception referred to the longitudinal ultrasound appearance of the intussuscepted segment of bowel.
- Crescent in a doughnut sign: This referred to the transverse ultrasound appearance of intestinal intussesception and was a variation of the target sign.
- Free fluid: The trapped free fluid indicated poor reproducibility and indication for surgery
- Absent blood flow: This indicated ischemia and necrosis of bowel.

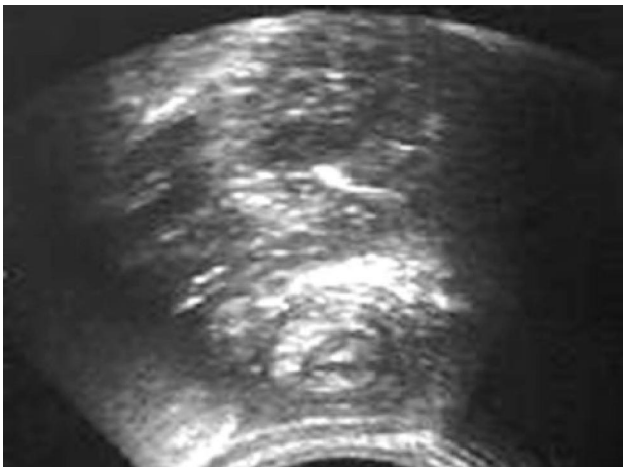


Figure 1: Abdominal ultrasonography reveals the classic target sign of an intussusceptum inside an intussuscipiens

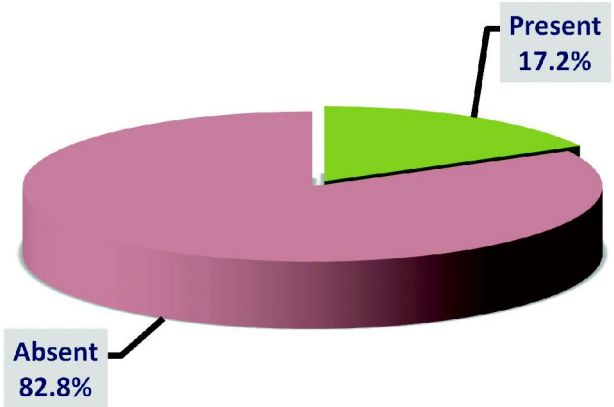
All the patients diagnosed as having signs of irreducible intussusceptions on color Doppler were followed after surgery.

Data compilation and analysis was done on SPSS version 21. Descriptive statistics were calculated. Quantitative variable i.e. age was expressed as mean ± SD and qualitative variables i.e. gender, clinical features, ultrasound findings, and surgical findings were presented in terms of frequency and percentages. Sensitivity, specificity, positive predictive value, and negative predictive values of ultrasound for detecting intussusception were calculated using 2 by 2 tables by taking surgical findings as a gold standard. Stratification was done with regards to age and gender to the see the effect of these on outcome.

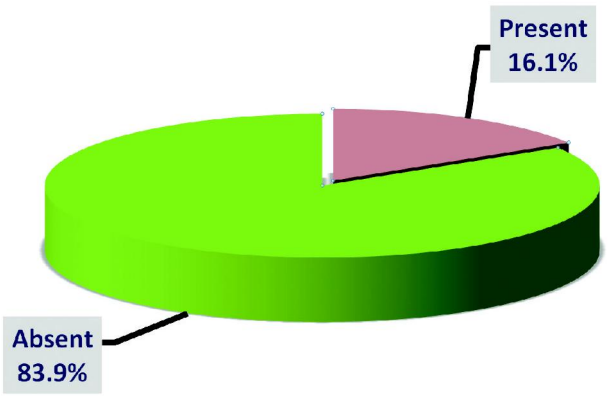
Results

In this study out of total study children, male were 109 (56.8%) and female were 83 (43.2%). The male to female ratio was 1.3:1. The mean age was 4.3 ± 2.3 years. Age of 136 (70.8%) children was ≤ 4 years and rest of the 56 (29.2%) children were aged >4 year. As far as clinical features at presentation are concerned, the results showed that colicky abdominal pain was observed in 85 (44.3%) patients, vomiting was observed in 30 (15.6%) patients, abdominal mass was observed in 16 (18.2%) patients, and Current jelly stool was observed in 16 (8.3%) patients.

On ultrasound examination, intussusception was diagnosed in 33 patients (Graph-1) and in surgical procedure it was found in 31 patients (Graph-2) and (Tab. 1).



Graph 1: Percentage of intussusception findings in Ultrasound examination



Graph 2: Percentage of intussusception findings in Surgical Examination

(n=192)		Frequency	%
Ultrasound Findings	Present	33	17.2%
	Absent	159	82.8%
Surgical Findings	Present	31	16.1%
	Absent	161	83.9%

Table 1: Frequency distribution for diagnosis of intussusception

In both ultrasound and surgical procedures, intussusception was diagnosed among 26 patients (true positive, correctly diagnosed) and it was not diagnosed in 154 patients (true negative, correctly diagnosed). The overall sensitivity of ultrasound was found to be 83.9%, specificity was 95.7% and diagnostic accuracy was 93.7% (Tab. 2).

(n=192)		Frequency		Total
		Present	Absent	
Ultrasound Findings	Present	26 (83.9%)*	7	**33**
	Absent	5	154 (95.7%)**	**159**
Total		**31**	**161**	**192**

*Sensitivity
**Specificity

PPV= 78.8%
NPP=96.9%
Diagnostic accuracy=93.7%

Table 2: Diagnostic accuracy of ultrasound for diagnosis of intussusception.

Post stratification analysis based on age showed that those patients whose age was 4 years or less had 81.0% sensitivity, 95.7% specificity, and 93.4% diagnostic accuracy and those patients whose age was more than 4 years had 90.0% sensitivity, 95.7% specificity, and 94.6% accuracy of ultrasound in diagnosis of intussusceptions. Stratified analysis

according to gender showed that male patients had 80.0% sensitivity, 95.7% specificity, and 93.6% diagnostic accuracy and among female patients sensitivity was 87.5%, specificity was 95.35%, and diagnostic accuracy was 94.0% of ultrasound in diagnosis of intussusception (Table-3).

	AGE		GENDER	
(n=192)	≤ 4 years	> 4 years	Male	Female
Sensitivity	81.0%	90.0%	80.0%	87.5%
Specificity	95.7%	95.7%	95.7%	95.5%
Positive Predictive Value	77.3%	81.8%	75.0%	82.4%
Negative Predictive Value	96.5%	97.8%	96.8%	97.0%
Diagnostic Accuracy	93.4%	94.6%	93.6%	94.0%

Table 3: Diagnostic accuracy of ultrasound for diagnosis of intussusception according to age and gender

Discussion

The traditional investigations with small bowel enteroclysis and small bowel follow-through reveal information sparingly, and unfortunately involve radiation exposure of the patient. Although it is an organ that is spared from frequent disease, more precise and patient-friendly methods are needed.[9] New imaging techniques have been developed that have proven useful. Computerized tomography (CT), magnetic resonance imaging (MRI), wireless capsule endoscopy and double-balloon endoscopy are all relatively new additions to the diagnostic armamentarium.

Ultrasound is accurate and cheaper compared to other diagnostic modalities in diagnosis of intussusception. The reliability of ultrasonography as a diagnostic tool for detection of intussusceptions (IS) has been widely debated.[10] In current study the overall sensitivity of ultrasonography in detection of IS was 83.9%, specificity of 95.7% and accuracy of 93.7%. A large-scale prospective study reported that ultrasonography is 97.5% sensitive and 99.0% specific for the diagnosis of acute IS in children in developing country despite the use of equipment which were older than are generally available in developed countries.[11]

Absence of radiation, non-invasiveness and rapid nature of ultrasonography have major clinical and technical advantages. Ultrasonography also enables follow-up screening to confirm reduction or investigate persisting symptoms.[87] Of the patients who were negative for IS on ultrasonography in this study, 94% did not proceed to air enema, avoiding exposure to radiation and the discomfort of undergoing an enema. Transient IS or spontaneous reduction can be observed using ultrasonography, obviating the need for enema reduction.[11-12] Additionally, colour Doppler US has been reported to aid prediction of reducibility of IS by enema.[13] Pracros et al.[14] have also shown that ultrasonography assists the diagnosis of other conditions including urinary tract pathology, ovarian disorders, necrotizing enterocolitis, cyst of the common bile duct and small bowel volvulus.

Due to the rare association between a rotavirus vaccine (Rotashield®) and IS, the World Health Organization has recommended that countries planning to introduce a rotavirus vaccine should develop post-marketing surveillance systems to promptly identify and manage cases of IS.[15] Many developing countries rely on ultrasonography for the diagnosis of IS. This study confirms the accuracy and reliability of ultrasonography for the diagnosis of acute IS.

Conclusion

Ultrasonography is an accurate, safe and valuable clinical tool in the diagnosis of acute intussusception in children. The use of ultrasonography as a primary investigation for patients with suspected intussusception prevented unnecessary radiological or surgical procedures being performed. Ultrasonography has been validated as a valuable tool for the diagnosis of intussusception.

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